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HUNTING SYNCHRONY IN WHITE-TAILED KITES

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examined whether kites hunted independent of other individuals hunting.

Hunting behavior of White-tailed Kites (*Elanus leucurus*) has been extensively studied (Bammann 1975, Warner and Rudd 1975, Mendelsohn and Jaksic 1989). Kites primarily use open to semi-open habitats for hunting (Waian 1973, Bammann 1975, Dunk and Cooper 1994). In California, kites almost exclusively hover while they hunt (Mendelsohn and Jaksic 1989, Dunk 1995) and prey on small mammals, primarily voles (*Microtus* spp.) (Hawbecker 1940, 1942, Stendell 1972).

In previous studies of kites, we observed that groups of kites (2–20 individuals) appeared to hunt relatively synchronously and the probability of an individual kite hunting appeared to be related to whether other kites were hunting. Hunting synchrony could result from kites advertising their presence to conspecific territory holders to potentially decrease subsequent interactions, or to more easily patrol and defend a territory, or from kites responding to variability in prey availability as a function of prey activity rhythms. Shields (1976, cited in Madison 1985) found California voles (*M. californicus*) exhibited ultradian rhythms in activity varying from 2–6 hr. Daan et al. (1982) reported positive correlations between vole activity and timing of hunting by raptors in Europe. We

STUDY AREA AND METHODS

This study was conducted at the Mad River Slough Wildlife Area, Arcata, California. The area consists of approximately 185 ha of ungrazed grassland with little topographic relief. It contains very few trees and shrubs, and fence posts and T-bars (ca. 3-m tall) provide most of the perches for raptors. The climate is maritime with mild winters and cool summers.

The study took place from 20 November 1994–30 January 1995. We made observations during seven 1–2 hr periods. Random points within the study area were established from which observations were made. Scan sampling (Altmann 1974) was used to record number of kites hunting. Using a landmark on the horizon as a starting point, we slowly scanned (\bar{x} time per scan = 90 sec, range = 45–135 sec) 360° and recorded the number of kites hunting (hovering). Scans were made using binoculars. All kites were within approximately 400 m of the observer. We waited 5 min between scans based on Bammann's (1975) findings that mean hunting time for kites was 5.04 min ($N = 674$ hunts) in this area.

To determine whether kites hunted independent of other hunting kites, we compared observed numbers of kites hunting during each scan to expected numbers under the Poisson distribution using Chi-square analysis. We used this analysis because comparison of observed events

Table 1. Number of White-tailed Kites observed vs. expected (using the Poisson distribution) to be hunting simultaneously at Arcata, CA 1994–95.

NUMBER HUNTING PER SCAN	NUMBER OF TIMES OBSERVED	NUMBER OF TIMES EXPECTED
0	43	29
1	31	41
2	21	29
3	13	14
4+	11	5

to the Poisson distribution allows a test of the independence of the individual events (Zar 1984). Groups of 4, 5, 6 and 7 kites hunting simultaneously had expected frequencies less than 5, so they were combined into one group (>4 individuals).

RESULTS

We observed 168 kites hunting during 119 scans. Mean number of kites hunting per scan was 1.41 (range = 0–7). Individual kites hunted in a nonrandom fashion with respect to the presence of other hunting kites ($\chi^2 = 19.36$, $df = 3$, $P = 0.0002$). Few kites (1 or 2) hunted less often than expected whereas many kites (≥ 4) hunted simultaneously more often than expected (Table 1).

DISCUSSION

We found that kites hunted in a nonrandom way with respect to the presence of other hunting kites. Our statistical test was probably conservative because data were analyzed as if there were always ≥ 4 kites on the study area that could have hunted simultaneously. On some occasions there were only a couple of kites in the sampling area. Thus, our analysis was probably biased against observing ≥ 4 kites hunting simultaneously more than expected. It appears that kites responded to either other individuals hunting or, very rapidly, to some other factor. It was beyond the scope of this study to examine whether kites were ultimately responding to vole activity rhythms, to other individual kites for territorial reasons, or both. Proximately, however, kites appeared to respond to other hunting kites.

Species such as Common Ravens (*Corvus corax*), Bald Eagles (*Haliaeetus leucocephalus*), and many vultures are known to forage together and “obtain information” about food resources from one another (Knight and Knight 1983, Heinrich 1988), often at communal roosts, but also through local enhancement (Knight and Knight 1983) where searchers are attracted to actively foraging individuals, or by actually recruiting other individuals (Heinrich 1988). Although kites are also communal roosters during the nonbreeding season (Bolander and Arnold 1965, Waian 1973, Clark and Wheeler 1989), their diurnal behavior during the nonbreeding season contrasts with other species in that kites hold hunting territories (Dunk and Cooper 1994). Moreover, amongst Common Ravens, Bald Eagles, vultures and kites, kite prey items are relatively more predictable spatially because they are not nearly as

patchily distributed and are of much smaller size. We propose that the information that nonhunting kites obtain from hunting individuals is not where to forage, as has been found for other species, but when to forage.

If kites were ultimately responding to variations in vole activity, nonhunting kites probably benefit by observing whether a hunting kite makes an attempt at prey (whether successful or not because any attempt is presumably in response to a prey detection). If no prey attempts are made, then nonhunting individuals should remain perched and thus conserve energy. If attempts at prey are made, then nonhunting kites should use this information to decide whether to hunt. If this “vole rhythm” hypothesis is correct, then voles should exhibit synchronous activity rhythms over relatively large areas, at least the size of our study area. Subsequent studies should examine the relationship between vole activity and the number of kites (and other raptors) hunting.

RESUMEN.—Nosotros examinamos si *Elanus leucurus* en el norte de California cazaba en sincronización mas que esperaban bajo el pronóstico Poisson. Nosotros encontramos que pocos *E. leucurus* cazaban con menos frecuencia de lo que esperaban y muchos (≥ 4) *E. leucurus* cazaban con mas frecuencia de lo que esperaban según parecen responder con la presencia de otros *E. leucurus* cazando. Finalmente, *E. leucurus* podía estar respondiendo a actividad rítmica de presa, a otros *E. leucurus* por razones territorial, o los dos.

[Traducción de Raúl De La Garza, Jr.]

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BLOOD PARASITES OF NESTLING GOSHAWKS

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KEY WORDS: *Northern Goshawk*; *Accipiter gentilis*; *nestling survival*; *blood parasites*.

There are a few studies which have investigated pathogenic effects of haematozoa on wild raptors. Ashford et al. (1990, 1991) were unable to demonstrate any effect of *Leucocytozoon toddi* on the mortality of nestling or adult European Sparrowhawks (*Accipiter nisus*) in England and Korpi-maki et al. (1993) showed no effect of *L. ziemanni* on body mass or molting progress in almost 200 Tengmalm's Owls (*Aegolius funereus*) in Finland. They did, however, find that four of six females which laid unusually small clutches had relatively heavy infections. In a second large study, Korpi-maki et al. (1995) found that mates of male European Kestrels (*Falco tinnunculus*) infected with *Haemoproteus* produced smaller clutches earlier than mates of uninfected males. It

is unfortunate that the precise ages of these birds were unknown as this was likely to be the confounding variable.

The occurrence of blood parasites in nestling Northern Goshawks (*Accipiter gentilis*) is unknown and, if they do occur, their role as a factor of regulation of goshawk reproduction is unclear. The aim of this preliminary study was to investigate occurrences of blood parasites and to assess whether they are a significant mortality factor in nestling goshawks.

METHODS

Nests of Northern Goshawks were studied from March through late July 1994. Clutch sizes were determined by viewing nest contents in late April and early May 1994 with a mirror attached to a telescopic pole. We climbed into nests between 11–14 June to sex, band, weigh and measure wing lengths (standard B.T.O. maximum chord: Spencer 1984) of nestlings. Body mass was adjusted for crop contents by subtracting 60 g if nestlings had full crops and 15 g if they had crops that were half-full or less. Wing-length measurements were used to age nestlings (± 4 d) from growth equations of Swedish goshawks (Kenward et al. 1993). The first

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